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Report of the Committee on School Hygiene.

Presented to the Section on State Medicine, at the Forty-fourth Annual Meeting of the American Medical Association.

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presented by the author —

REPRINTED FROM
THE JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION.
NOVEMBER 11, 1893.

CHICAGO:
PUBLISHED AT THE OFFICE OF THE ASSOCIATION.
1893.

REPORT OF THE COMMITTEE ON SCHOOL HYGIENE.

Upon the formation of the Committee it was thought best to divide the work among the members, assigning a separate department to each. It has been found in practice, however, that the ground has not been fairly covered by this plan. Long and careful special papers have been prepared and published by some of the members, while others, though deeply interested in the work, have not found time to treat their assigned subjects in a manner which would justify them in publishing results. It has, therefore, seemed best to the Chairman of the Committee to take the responsibility of drawing up a brief but comprehensive statement of principles, covering all the topics; submitting the whole to each member, and presenting the matter to the Section of State Medicine.

It seems desirable in doing this, to avoid statements which are open to reasonable doubt. It is thought that the most useful result can be gained by a simple untechnical presentation of facts omitting discussions, statistics and arguments; with the object of securing the attention of school authorities, teachers, builders, and others interested in education.

A—SITE, DRAINAGE AND SEWERAGE OF SCHOOL BUILDINGS.

1. Good Light.—This point has been seriously neglected in many city sites, for financial reasons. The neglect to secure good light has been demonstrated to be an important cause of near-sight in scholars. The desired object can be attained by

reserving a tolerably wide strip of land around the school building at the outset, and by municipal regulations restricting the height of neighboring structures. It is suggested that the height of such buildings around schoolhouses should not exceed one-half the distance between them and the schoolhouse; or, that the line drawn from the foot of the school house wall to the upper part of the other house should not form an angle with the horizon exceeding 30 degrees. In small towns the space for play grounds should be much greater—at least a half acre.

2. Sunlight.—If possible, the sun should enter every room in the house at some time in the day, but chiefly out of school hours. The play grounds should be placed, if it can be so arranged, on the sunny side of the house. There should be no trees overshadowing the house, since this causes dampness.

3. Neighborhood.—Disturbing influences, as the presence of large bodies of working people, railroads, noisy streets, engine houses, are injurious for various reasons, partly as furnishing undesirable outside associations. Immorality or filth should not be suggested in the surrounding neighborhood. A main city street is commonly to be avoided. The vicinity of offensive trades, as tanneries, rendering establishments, refineries and gas works, is to be avoided.

4. Soil.—A damp soil is of itself a serious objection to a site. The case is worse if the site be low, with poor natural drainage and poor opportunity for artificial relief. If it be necessary to build on a springy piece of ground, a trench must be dug around the foundation to a depth below the cellar floor, and far enough from the building to insure the safety of the walls; in this, drain tile with loose joints is laid, discharging away from the building at some lower point. It is useless to cement the cellar wall or floor for the purpose of excluding water, but cement or asphalt forms a good protection against dampness.

School yards in towns should be so paved (not graveled), and underdrained if necessary, as to become dry within an hour after a rain. Dry walks should lead to the out-buildings.

5. *Out-buildings.*—If privies are employed, they should never be within fifty feet of the main building. They should be separate for the sexes, with entirely separate paths of access, and having a board fence between. Dry earth or sifted ashes should be sprinkled over the contents once a day. The entire contents should be removed once a fortnight. The receptacle must be so constructed that such removal can be effected easily and completely; or it should itself be removable with its contents. An iron trough on wheels, or a metal pail is suggested.

Urinals must not be made of iron, and they had better not be made of any metal. Impervious material, such as glass or oiled slate, is best. Cement is very objectionable from its porosity. Joints between slabs should be perfectly tight.

6. *Water-closets*—When a supply of water is at hand, water closets are the best arrangement. They may either be single, or may consist of long troughs corresponding to a number of seats. The pan closet is undesirable, since its inner parts are not freely cleansed by the flow of water. Of the simpler forms of closet, all those which do not furnish a quick and free discharge of water, cleansing the bowl thoroughly and removing all the contents within a few seconds, are to be absolutely rejected. A noisy apparatus is exceedingly objectionable for closets which are placed (e. g. for teachers' use) in the vicinity of schoolrooms; the noise may proceed either from the tank or the basin.

One of the simplest forms of apparatus for schools is the long tank of cement or iron placed under the range of seats. The bottom is covered with a few inches of water, and slopes to an outlet so that by raising a plug the whole contents are quickly dis-

charged into the sewer, after which cleansing is easily effected by a hose and broom. The addition of an automatic flushing apparatus acting spontaneously at fixed intervals has been found desirable.

All closets and urinals in a schoolhouse must have special ventilation by forced draught. No mechanical contrivances or disinfectors do away with the necessity of personal inspection and faithful cleansing by hand.

7. *Plumbing.*—The principles of drainage and sewerage, commonly termed the art of plumbing, are the same for school buildings as for other edifices. It may be stated, that pipes and other fixtures ought to be so placed that they can be *seen* by lifting movable boards, without having recourse to a carpenter, or mason, or plumber to disclose their intricacies.

It should further be understood, that the whole system is under the control and supervision of some responsible and intelligent person, who possesses sufficient plans and drawings of the system, and pays frequent attention to its condition.

B—CONSTRUCTION.

1. *Safety.*—The chief danger is found in old buildings, and in those not originally intended for their present use. In such, we occasionally find conditions which are nearly sure to cause accidents in case of a panic. The staircase is the important point. It must be very strong, wide and easy; not steep, not sharp-angled, not spiral or with wedge-shaped steps; it should have a platform at the turn. It is safer without a well; if balusters are used they must be high. In large buildings a staircase should be placed at each end. Halls and outer doors must be wide, and all doors open outward. Fire-escapes on the outside are at best an undesirable refuge, and in the ordinary forms may be very dangerous to a crowd of frightened children. Discipline and prac-

tice in "fire-drill" or quick orderly march from the school, are by far the best safeguards.

2. The Schoolroom.—The size of a class room should be governed by the number of pupils it is intended for. If we assume that 50 can be attended to by the teacher, and that 200 cubic feet of space is allowed per head, a room 24x33x12½ will answer well. The oblong shape is desirable. If the dimensions here given are exceeded in length, there will be difficulty on the teacher's part in supervision and on the scholars' part in seeing what the teacher may show or write on the board. A greater depth or distance from the windows than twenty-four feet will impair the lighting.

3. Illumination.—The lighting of a room for school work requires a much larger allowance of window space than is needed for dwellings. The windows must be square-headed, and brought very near the ceiling; there must be no projections (cornices, piazzas, Italian shades) to interfere with the free entrance of light. The total amount of window glass on a liberal allowance may equal one-fifth the floor space; if fully exposed to the sky, less will suffice. Roller shades are of most use when the roller is placed at the foot of the window. Light coming wholly from one side (viz., the left hand) if sufficient in amount, is the best for the eyes; if this plan in any case appears likely to give insufficient lighting, owing to local conditions, windows may be added at the back, possibly also at the right (but in the latter case, at a very high level). Windows in front of the pupils are very injurious to the sight. The wall should be colored of a neutral tint, or with a faint shade of blue or green if liked. The ceiling should be white. It must have no cross beams placed transversely to the light. Blackboards must not be placed between windows.

4. Miscellaneous.—The size of recitation rooms must be planned upon the same principle as that of

schoolrooms, viz., that of allowing 200 cubic feet per scholar.

It is desirable, where possible, to limit the height of a building to two stories above the street, inasmuch as injury not infrequently results from the excessive strain of climbing upstairs.

Accommodations for hanging clothes should be furnished outside of class rooms, with good provision for ventilation. Enclosed spaces in the halls, open at top and bottom, are suitable.

Cellars or basements must be high, dry, well-lighted and thoroughly wholesome. If there is no cellar, there must be a dry sub-floor space under the whole building.

Dust being a destroyer of pure air and a foe to health, care must be taken to avoid for floors such material as produces dust; if of cement, it must not crumble; if of wood, it must be "filled" so as to be impervious.

C—VENTILATION AND HEATING.

A very large proportion of schools are so poorly provided with ventilating arrangements that they are practically dependent on open windows. To relieve this unfortunate state of things, the lower sash may be raised two inches (less, in stormy weather) and a board placed in front to deflect the air upward. The upper sash (which ought always to be movable) may be lowered an inch. These measures are attended with little risk, and give perceptible, though partial, relief.

Perforations in the sash, window pane, or wall, also give some relief. Such methods may provide sufficient air for five or six persons in a room, but are entirely inadequate for the supply of a whole class.

The attempt to ventilate schoolrooms in cold weather by the windows, in the Northern United States is either very dangerous to health or very ineffective, or both. The amount which can safely be

admitted in this way may be one-fifth to one-tenth of what is needed. The existence of ventilating flues or openings does not of itself insure good ventilation. Flues may be too small, or crooked, or partly or wholly stopped up; they may discharge into other rooms or the attic instead of the outer air; they may be unprovided with means for causing the air to rise in them; they may be in many ways badly planned. To enumerate the faults which may be committed would require a treatise.

It ought to be understood by every one concerned in ventilation that large collections of persons require very large amounts of air; that the amount should be calculated, and the size of the flues determined before the house is planned; that true economy requires us to consider the system of heating and that of ventilation as inter-dependent parts of one and the same problem; and that both should form a part of the original architectural design.

The amount of fresh air to be brought into the building for each pupil should be 2,000 cubic feet per hour for younger children (under 10) and 3,000 for high school pupils. These amounts are calculated from the assumptions that the external "pure" air contains an average of 4 parts of CO_2 in 10,000; and that when the CO_2 has increased under the influence of respiration, to the amount of more than 6 in 10,000, the air may be considered "impure." Dilution, to the extent mentioned above, will keep the air of the room below the point of "impurity," here assumed. The purity required by this standard is such that persons coming fresh from out of doors will not perceive any distinct closeness in the air of the schoolroom.

As regards the relative requirements at different ages, it may be assumed as proportionate to the different amounts of CO_2 exhaled by people of different ages. In the case of children of 8 years, it is about two-thirds as much as in young persons of 15.

If a lower standard of supply is taken (say 1000–

1500 c. f. per hour), there will be a perceptible deficiency of purity, which will have to be made up by an hourly opening of the windows on the occasion of recess.

If the cubic contents of a schoolroom equal 200 c. f. per head, the entire air contents of the room will thus be renewed every four to six minutes. It is found by experience that the draught caused by the in-rushing air need not be troublesome in rooms which allow this amount of space per inmate. It is recommended that this be the average allowance of space.

In testing air for CO_2, it is important to take samples from the level of the pupils' heads, avoiding the admixture of the breath. If the condition of the air at that level is satisfactory, the end of ventilation has been gained.

The rapidity with which the air leaves the room may be ascertained by the use of the anemometer. In addition to this test it is desirable to apply the chemical test for comparing the discharged air with that of different parts of the room; for if the supply of fresh air is badly distributed, it may happen that in some parts of the room the currents are comparatively stagnant, and the air will grow more impure than the average of the room.

The animal impurities of the expired air (exclusive of CO_2) are probably, in part, of a poisonous nature. They, perhaps, include ptomaines as results of putrefactive decomposition. They are of infinitely more importance than the CO_2 which is associated with them; but they can not be conveniently made the subjects of quantitative test. Hence, the CO_2 test is employed, as indicating with *probability* how much the air has been affected by respiration.

The mere removal of foul air, whether by stoves, fireplaces, or ventilating flues, accomplishes but one-half of the duty of ventilation. The other half consists in supplying a quantity of fresh air equal in bulk to that removed. It often happens that no

special provision is made for this supply; in this case the entering air is drawn from many sources—out of doors, the halls, the closets, the cellars, and indirectly from many undesirable places. Special ducts, therefore, are requisite for leading the pure outer air in large quantities to the schoolroom.

Such large quantities of air as are required can not be safely introduced without previous warming. But the rapidity with which the air is changed is so great that a high temperature is not required; as a rule, heating can be effectually performed with air not hotter than 100 degrees Fah. If the ventilation is sluggish, the air needs to be made correspondingly hotter in order to keep the room warm; but air thus over-heated is apt to have an odor which indicates that it has been in some way injured in the process.

The locality from which the air supply is drawn should of course be such as to avoid impurities—dust, smoke and bad smells.

A system of ventilation which is working well and sufficiently will produce a near equality of temperature in all parts of the room. The difference between the temperature at the floor level and that at five feet from the floor should not exceed 5 degrees.

A system is efficient in proportion as it maintains its activity under widely varying outside temperatures. Ventilation is needed at 40 degrees as much as at 0°, but it is much harder to keep up a sufficient action in the former case. If the system is based on the draught of heated flues, some additional means for increasing the heat of the flues ought to be available for such mild weather.

The relative humidity of air commonly breathed in our winter climate is low, compared with that in Western Europe. It becomes of necessity still lower when warmed. It is not, however, proved that the dryness thus obtained is generally prejudicial to health, either in schools or hospitals, although some individuals appear to require greater moisture. A part, if not the whole, of the unpleasant effect of

breathing super-heated air is due to the bad ventilation, and the excessive temperature.

The thermometer placed at five feet from the floor should mark an average of 65 degrees to 70 degrees in our climate. This is considerably higher than is found desirable in Western Europe.

It is to be presumed that the entering air is warmer than that which leaves the room, since it contributes a fraction of its heat for the warming of the walls and windows. If introduced at the upper part of the room, it will therefore fall towards the floor by degrees as it becomes cooled. Hence a level near the floor is a natural one for its exit. The proportion of CO_2 at the upper level of the room is not essentially different, on the average, from that in the lower part, and the level of the orifice of extraction is a matter of indifference as regards that point. If it be our object to get rid of superfluous heat, we should discharge the air from the top; this, however, is not to be considered normal or regular, but only to be applied when heat is excessive, as (for instance) in evening schools with artificial light.

It is possible to apply the above principles to the ventilating of the smallest school house. A single room can be heated with an upright cylinder stove of ordinary construction, having around it an air space enclosed by a jacket of sheet iron. In the floor beneath the stove an opening is made, connecting with a flue led to the outer air, through which there will be a rapid and abundant inflow of pure warmed air. The supply flue may run in two directions, so as to be exposed to different winds, and each point of opening should be guarded with a valve. For the escape of foul air, openings near the floor are made in the brick chimney-flue, which should stand at the far end of the room. The stove funnel is carried across the room into the chimney, and its heat insures an upward draught. Open grates and ordinary stoves are aids to ventilation, but perform only a small part of the duty required.

"Direct radiation," or the use of steam heaters in the rooms to be warmed, furnishes no supply of fresh air. If ventilation is fully provided for, as above described, direct heating is admissible as *supplemental* supply in exceptional cases; but as a rule its use is destructive of good ventilation.

Effective work can be done either by furnaces or by steam heaters in the cellar ("indirect" radiation). In both cases it is exceedingly desirable to provide liberally in respect to the size and power of the apparatus.

On the question of *economy* in ventilation, and the *necessary expense* of good ventilation, much may be said. A great amount of warm air is necessarily thrown away in ventilation. It is estimated that a very perfectly ventilated building, filled with students, expends 50 per cent. more coal than the same building empty and closed, the temperature being the same. This difference would be greatly lessened if we could compare the case of a well ventilated, occupied building with one badly ventilated and occupied; the latter wasting, as it does, a considerable amount of heat by open windows and by the over-heating which often accompanies bad ventilation. It is certain that the additional annual expense per pupil, of the best ventilation, need not exceed the price of one or two cheap lunches. The effect of perfect ventilation, where it has been tried, is, to increase the pupil's power of work about 50 per cent. which is a direct saving to the town that pays for his schooling. To which must be added the gain in public health (which is not easily to be estimated); since a large percentage of school children are suffering at present a perceptible diminution of vigor from the effects of foul school air.

The employment of automatic regulators for keeping school rooms at a given temperature is recommended as both economical and healthful. Modern methods often uselessly overheat the cellar in which the furnaces stand. Waste steam from the boilers

ought to be converted to the use of heating radiators. A liberal salary to janitors or engineers may insure a more intelligent control of the fuel.

The available methods for compelling air to move in ventilating flues are practically two: 1, the ascensive force of heated air; 2, fans driven by steam or electricity for forcing air into the room or drawing it out by "suction." For the former method, it is generally desirable to make available the otherwise wasted heat of smoke flues, by causing them to run in the foul-air shaft.

D.—PERSONAL HEALTH.

1. A *minimum* age for entering primary schools may properly be stated as five completed years.

2. The program of daily work for little children should be widely different from that for older ones. A forenoon session may last three hours; but no exercise should last continuously more than fifteen or twenty minutes. There should be a constant change of activity, passive attention alternating with active work; recesses of a few minutes coming very frequently, and recesses of fifteen or twenty minutes at least twice in the session. Adherence to one posture should be required for only a very few minutes at once. Singing should come in more than once during the session. If an afternoon session of two hours be added, the tasks should be lighter than the forenoon tasks. Two hours must intervene between the sessions. The total amount of task-work and recitation required in primary schools may equal half the nominal period of the sessions.

3. Young persons of both sexes at periods of rapid bodily growth, and especially at that of sexual development, not infrequently require special relief or rest from school-work, which in the case of girls may come at periodical intervals.

As the age increases, the power of concentration and continuous work is strengthened. At the age of 14, *five* hours of sessions will be equivalent to *four* or

four and a half hours of work; to which an hour of home study may rightly be added. The usual length of recitations at this age may be about half an hour; long recitations encourage listlessness. For pupils of full growth (18), eight hours of school sessions and home work is an average *maximum*. This does not exclude the possibility of a greater amount of work for limited periods in exceptional cases among advanced pupils in vigorous health. It is presumed in these estimates that the school has two half holidays or one whole holiday weekly.

4. The attention of teachers and parents should be called to the necessity for wholesome and sufficient meals for scholars; especially, breakfasts and lunches. The health of many children is supposed to suffer from over-study, when the chief cause of the mischief is neglect to eat a proper breakfast; or the substitution of pastry and sweets for plain lunch. The establishment of lunch counters for the sale of hot milk, cocoa and plain food would be very beneficial in the case of many city schools. Lunch is not a superfluity, but a necessity, in cases where long sessions and distant residences keep the pupils away from home five or six hours at a time.

5. The systems of calisthenics in common use—free-hand exercises in full class rooms, for five minutes at a time—serve a very useful purpose as a partial relaxation, but are quite inadequate, considered as a means of bodily development. For the latter purpose, gymnastic training of a more serious kind is very desirable. Its influence is felt in the development of the mental faculties; it adds force and firmness to the moral nature; it furnishes an important correction of those depressant influences of city life, which have a tendency to lower the vitality of millions of our population at the present time. It is hoped that the systematic teaching of gymnastics to all our public school children may soon become an indispensable part of the school course, but it must always be remembered that the more violent athletic

sports tend to heart strain and other disabilities that shorten life.

6. The habit of constipation is often acquired as a result of deprivation of bodily freedom, and confinement to a stooping or sitting posture, together with the mental tension of school work and the sense of constraint. In order to avoid this great evil and its frequent attendant, dyspepsia, it is desirable to give recess with liberty of play out of doors, as often as is convenient. This is especially applicable to young children. Retention of urine now and then occurs under too strict school discipline, and may work serious injury. The friendly oversight of a teacher at recess is desirable, often indispensable.

E—EYESIGHT.

The eyes are often affected injuriously by school work carried to excess, or conducted amid unwholesome surroundings. There is a strong tendency to the production of near-sightedness; which can, to a great extent, be remedied by the avoidance of known causes. Among the direct causes of near-sight are—bad light, bad position at work, too protracted work, bad print; and to these must be added, as indirect causes, bad ventilation and heating, poor food, and whatever impairs the vigor of health.

Light in schoolrooms should never strike the pupil in the face while at work.

Excess of light is less common than deficiency, but is also harmful. No desk can be more than twenty feet from the windows of an ordinary schoolroom (supposing the top of the windows to reach the height of about twelve feet from the floor) without impairing the light.

A stooping position, and the wearing of tight neck-clothing, while at work, are injurious to the eyes.

To prevent scholars from taking bad positions in writing, it is recommended that children be directed to sit upright, facing the desk squarely, and be taught vertical writing. Also, that desks be slightly inclined;

their front edge to overlap the edge of the seat a little; and the height to be such that the fore arm easily passes over it. Seats ought to support the back and shoulders in reading, without favoring a tendency to lounge. The foot must rest firmly on the floor or on a foot-rest. The average graded school requires three sizes of desks and seats to each room.

The habit of holding work too near the eyes strains them and fosters a tendency to near-sight. For the youngest children, this distance should be not less than 25 cm. = 10 inches; for those of 8 to 10 years, 33 cm. = 14 inches. Badly proportioned desks and seats, especially where they are too far apart, favor this habit.

The eyes should have some rest from tasks every half-hour. Fine embroidery, fine detail in map-drawing, or penmanship, and the use of fine type, must be discouraged.

Such defects as far-sight, astigmatism, and affections of the muscles of the eye, are rather common in school children; they often cause headache and other forms of illness. The remedy lies in the use of suitable glasses, as prescribed by physicians. Test-types may properly be used by teachers to ascertain what scholars have marked defects of sight.

F—SANITARY ADMINISTRATION OF SCHOOLS.

The duties comprised under this head may properly be intrusted to one man in small places; in large towns a division of work will be necessary. The officer upon whom the charge is laid—or in all cases, the chief officer—must be a well-educated physician, with a special and practical knowledge of sanitary science. He should be appointed by the school authorities. He is here designated the medical school officer. It is the duty of this officer to satisfy himself (by personal inspection, if necessary) that all children admitted to school are protected, either by successful vaccination or a previous attack of the disease, against smallpox. He should also formulate,

and have power to enforce, in conjunction with the State or municipal health officers, regulations to prevent the dissemination of infectious diseases through the schools.

All plans for school buildings, premises and appliances should be submitted for his approval in sanitary points. Personally or by deputy he should examine all buildings and premises, with reference to the arrangements for ventilation and heating, size and lighting of rooms, furniture, water closets, urinals, drains, plumbing, water supply, safety from fire, and other points affecting health or safety. He should have the right of entrance at all times, and should be armed with ample powers.

The medical school officer should give personal instruction to teachers, of a practical kind, embracing: 1, an explanation of the existent sanitary regulations, with such physiological reasons and comments as may seem called for; 2, explanation of the sanitary arrangements existing in the schools, their practical management, and so much of the theory as may seem desirable; 3, explanation of the structure and use of the eye, and other parts of the bodily frame, with remarks on food, clothing, recess, study and kindred topics, so far as it seems to him desirable and useful to enter upon such considerations.

The said officer has medical authority in cases of immediate exigency, but is not authorized or expected to bestow further medical care as a part of his official duty. The extent to which personal medical *inspection* of scholars is made, and individual medical *advice* is given, must vary much with different classes of the population. It is not susceptible of extended adoption at present in America.